Abstract

A novel detection technique to estimate the amount of chirp in fiber Bragg gratings (FBGs) is proposed. This method is based on the fact that reflectivity at central wavelength of FBG reflection changes with strain/temperature gradient (linear chirp) applied to the same. Transfer matrix approach was used to vary different grating parameters (length, strength and apodization) to optimize variation of reflectivity with linear chirp. Analysis is done for different sets of 'FBG length-refractive index strength' combinations for which reflectivity vary linearly with linear chirp over a decent measurement range. This work acts as a guideline to choose appropriate grating parameters in designing sensing apparatus based on change in reflectivity at central wavelength of FBG reflection.

A novel high sensitive FBG strain sensing technique using lasers locked to relative frequency reference is proposed and analyzed theoretically. Static strain on FBG independent of temperature can be measured by locking frequency of diode laser to the mid reflection frequency of matched reference FBG, which responds to temperature similar to that of the sensor FBG, but is immune to strain applied to the same. Difference between light intensities reflected from the sensor and reference FBGs (proportional to the difference between respective pass band gains at the diode laser frequency) is not only proportional to the relative strain between the sensor and reference FBGs but also independent of servo residual frequency errors. Usage of relative frequency reference avoids all complexities involved in the usage of absolute frequency reference, hence, making the system simple and economical. Theoretical limit for dynamic and static strain sensitivities considering all major noise contributions are respectively of the order of $25\, p\varepsilon/\sqrt{Hz}$ *and* $1.2\, n\varepsilon/\sqrt{Hz}$.